

5 Indigenous engineering feats you should know about

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For many millennia, Indigenous Australians have engineered the landscape using sophisticated technological and philosophical knowledge systems in a deliberate response to changing social and environmental circumstances.

These knowledge systems integrate profound understanding of Country, bringing together an understanding of the topography and geology of the landscape, its natural cycles and ecological systems, its hydrological systems and its natural resources, including fauna and flora. This has enabled people to manage resources sustainably and reliably.

Engineering is about process, and the process of engineering was very different in Australia before the English colonised the land. However, when our Aboriginal or Torres Strait Islander students take the step into engineering, or other STEM subjects, there is little material provided that relates to their experience or their peoples' technical and management knowledge. This is a result of historic denial of the First Nations of Australia as enduring scientific and technical civilisations.

The versatility and minimalist nature of Aboriginal technology designs are inspiring. The flexibility and artistry in tool manufacture, which can differ in neighbouring communities, is a salient lesson for engineers now. Some key aspects of this approach can be seen through five examples of ingenious Indigenous engineering.

Read more: Ten classics of Indigenous design

The Kimberley raft

The King Sound region of the Kimberleys in Western Australia is renowned for its strong tides, rips and whirlpools. Navigation can be difficult, though there are areas of calm water in the bays. The Bardi community, from One Arm Point, call their raft the *kalwa*.



Side view and plan of the kalwa raft, a traditional watercraft from the Bardi community of north-west Western Australia. Permission from David Payne, Curator at the Australian National Maritime Museum.

The raft is made mostly of light mangrove wood, providing buoyancy. The two fan-shaped sections that make up the boat are wider and thicker at the outer ends to provide stability. These two sections, lapped over each other, are made on a base of mangrove trunks sharpened at the ends; hardwood is used to pin them together. A small basket, made with hardwood pegs on the back section, is used to secure belongings or any fish that are caught.

The design ensures the top of the raft stays above the water when loaded with the paddler, passengers and belongings. The size of the raft determines the load it can carry. Water that washes over the raft will flow out through the gaps between the wooden slats.

Ingeniously, the structure can be pulled apart. One half can be tied to a harpooned dugong, which will swim around and become exhausted, while the hunter floats on the other half.

Rafts were made in different styles all around the coast of Australia, from the different materials available in particular areas and for uses relevant to that landscape.

Thuwarri Thaa Aboriginal ochre mine

The Thuwarri Thaa (aka Wilgie Mia) Aboriginal ochre mine is located in central WA in the Weld Range, between Mount Magnet and Meekatharra. It has been in use for probably tens of thousands of years, including by non-Aboriginal miners from the 1940s to 1970s.

The ochre is still important in body and artefact painting for ceremony. It is also used as a skin coolant during summer and for warmth during winter; as a fly repellent; in curing hides and in making glue.

The mine is a deep, sloping shaft cut into the mountain. Wood was carried into the cavern and made into scaffolding to reach seams of ochre out of reach above the cavern floor. Tunnels have been dug along seams in the walls. Heat, flaked pebbles and fire-hardened, sharpened wood were used to undercut the seams of ochre. Fire may have been used to crack the surrounding rock, as well as to provide light deep in the cavern. At times, large sections of ochre could be wedged off.

The ochre was mined from deep underground and then processed onsite. Some was transported by traders northwest to Carnarvon (450 km), south to Kellerberrin (525 km) and east to Wiluna (300 km). To transport, the ochre was dampened and rolled into balls.

Thuwarri Thaa was reserved as a men's only site and stories pass down knowledge of the site and the material. Its location, its mining and its uses are embedded in the creation story of the *marlu* or red kangaroo. The red ochre is his blood, the yellow ochre is his liver and green is his gall. The entire mining and distribution industry was regulated by these cultural constraints and influences and thus maintained sustainable practices.

When non-Aboriginal people mined there, the roof was blasted off a large cavern at a nearby site, little Wilgie Mia. Ochre from the site is still used in ceremony. People can visit with a permit if guided by Wajarri Yamaji Traditional Owner guides.



View towards Little Wilgie hill in 2015. (Courtesy of Anneliese Carson).

Read more: *Buried tools and pigments tell a new history of humans in Australia for 65,000 years*

Budj Bim eel traps

The Budj Bim area (also known as Lake Condah), a dormant volcano in south western Victoria, was continuously occupied for thousands of years. The Gunditjmara community farmed eels and harvested galaxia fish in a series of dams and water channels constructed out of the basalt lava flows, an amazing surveying feat.

More than 30,000 years ago, Budj Bim (called Mount Eccles by Europeans) spewed forth the Tyrendarra lava flow, a significant creation event in this country recorded in local oral history. The lava flow to the sea created large wetlands by changing the drainage pattern. This volcanic activity lasted until after the last ice age. Carbon dating shows aquaculture began as early as 6,700 years ago, soon after the lava flow stopped.



The Budj Bim world heritage site. Office of the Premier of Victoria/AAP

The people then continued to alter the water flow through the region with excavated channels. The channels are made in straight or curved paths, with sharp corners helping to reduce the speed of water. Dam walls were built to produce ponds.

These traps for eels and the fish traps in other locations were designed to allow animals to enter the trapping area, be retained in the cooling water and then captured when required for food. The eels remained in pools

designed for collection for long periods, where they would breed. This provided a food supply all year round.

The rock was also used to construct dwellings or stone huts, along with 36 storage structures and 12 pits, which are associated with eel trapping. Most of the stone dwellings have a diameter of less than 1.6m. The rest are considered to be storage caches. The area has many scar trees with signs of burning; many of the Manna gums were used for baking and smoking and preserving the trapped eel. Smoked eel products were traded over a wide area.

The structures were exposed during heavy fires in the area and the extent of the all the engineering work is still not known. These traps are an Australian UNESCO World Heritage site, the only one listed exclusively for its Aboriginal cultural values. The Gunditjmara people now work with engineering students designing projects exploring engineering approaches embedded in the landscape.

Read more: The detective work behind the Budj Bim eel traps World Heritage bid

Yidaki

When Ben Lange, an Aboriginal man from Cairns who plays the Yidaki, came to the University of New South Wales to study electrical engineering, he worked with the physics department to look at how the Aboriginal people created sounds with [this instrument](#). This work led to greater understanding of the use of the mouth and its components in speech production, providing inspiration for new approaches in speech therapy.

The Yidaki (European name the Didgeridoo) is a drone pipe played with circular breathing – the lungs are used as a form of air storage to maintain a continual flow through the pipe. The wood is selected from termite-hollowed trees. This bore is widened by hand, especially at the base of the pipe. Bees' wax is used to smooth the mouthpiece.

The shape of the mouth across the pipe, the control of air through the mouth with the diaphragm, and the position of the tongue in the mouth, as well as the shape of the player's voice box, all affect the sound from the instrument.

Read more: Friday essay: the remarkable yidaki (and no, it's not a 'didge')

Brewarrina fish traps

The Brewarrina fish traps, called Biame Ngunnhu by the local Ngemba people, were created by Biame in the Dreamtime – there is no oral record of other events that locate the period of construction. They are considered the oldest and longest-lasting dry wall construction on earth.

Dating of the traps would be hard, especially as many of the stones were recently moved to construct a stone weir across the river. Importantly, these fish traps provide an example of collaborative knowledge sharing and governance.



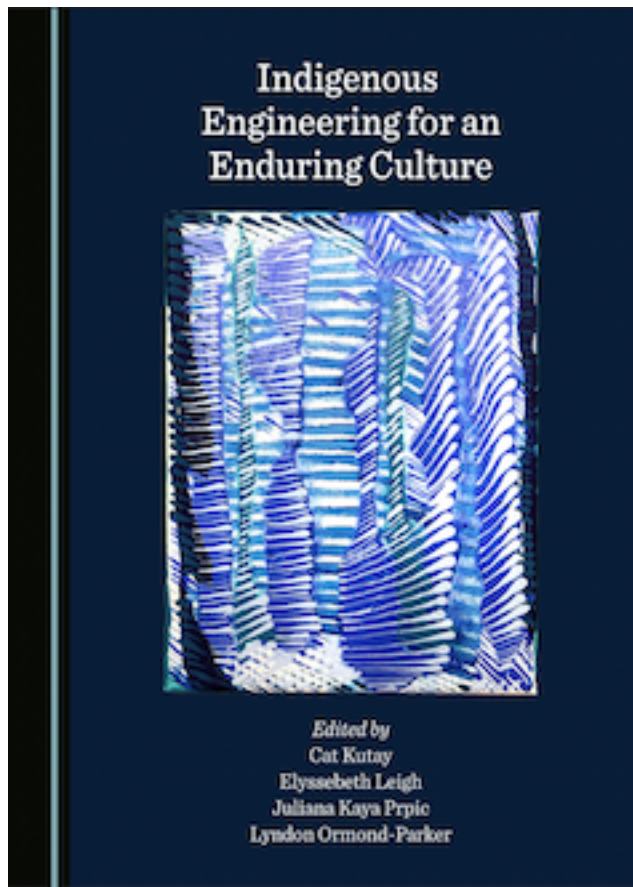
Fish traps on the Darling River at Brewarrina. Dean Lewins/AAP

When the fish were running in the Barwon River, a tributary of the Darling, the clans would gather from all around to talk about caring for Country. The fish traps are scattered across and down the river. When the water is high, the lower traps are inundated, but the upper traps are opened upstream and fish swim in with the water flow. They are closed and the fish remain in the traps until they are ready to be caught, usually by spear. When the water drops, the lower traps are then used.

Read more: [Budj Bim's world heritage listing is an Australian first – what other Indigenous cultural sites could be next?](#)

The Ngemba families each owned a trap, each feeding a specific language group when they came to the meetings. The time was spent understanding what was happening to Country around them – through sharing stories, and planning ceremonies, such as rain-making, as needed. This history of knowledge-sharing is now being continued by the Ngemba people with a project for online storytelling and data collection around service provision in their community.

The fish in the river include Australian grayling, river blackfish, short-finned eel, Australian smelt, climbing galaxias, common galaxias, congoli, flathead gudgeon, mountain galaxias, pouch lamprey, smallmouth hardyhead, trout galaxias and southern pigmy perch. However the main fish there now are introduced carp, and the high level of irrigation upstream means the river is often dry.



There is great diversity of Aboriginal peoples across Australia. Aboriginal people have different languages and come from vastly different landscapes, each with their unique ecology. Yet technology is part of our everyday life: the houses we live in; the internet we learn with; the watercraft we use for fun or fishing.

Indigenous communities need students graduating with the skills to help maintain and build infrastructure or create software to support their enterprises and care for Country. In project management, the participatory democracy practised in Indigenous communities is a good example of flat management processes and a way to reinvigorate the Western approach to sustainability and democracy that is failing in our engineering projects – as much as in the political space.

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